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Technical Report No. 6305

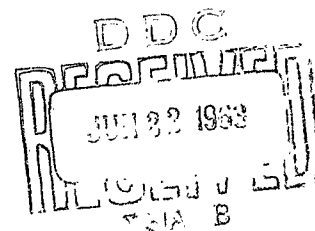
FABRICATION OF A POROUS POLYESTER DOUBLE-WALL,  
BELOW-ELBOW PROSTHESIS, TWO-STEP METHOD

Reported by: James T. Hill

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U. S. ARMY PROSTHETICS RESEARCH LABORATORY  
WALTER REED ARMY MEDICAL CENTER  
WASHINGTON 12, D. C.

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Recommend Approval:

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Director

\*Qualified requesters may obtain copies of this report from ASTIA.

## I. INTRODUCTION

In a previous report (T.R. 6204) several methods for preparing porous epoxy prostheses were described. Since the publication of this report our laboratory has developed a technique for preparing porous polyester prosthesis. This technique, although similar to the epoxy method, is sufficiently different to warrant a separate report. This report describes a two-step method for preparing porous polyester prostheses.

## II. PROCEDURE

### 1. Mold Preparation

Prepare the stump model in the usual manner. Place the model in a vise, distal end up, coat it with a release agent such as Hi-Glo. Allow this coating to dry.

### 2. PVA Sheet

Moisten a sheet of polyvinyl alcohol (PVA) and stretch it down over the stump model. Tie at the base. If preferred, use a PVA sleeve and then cap with a sheet of PVA and heat seal.

### 3. Sew Stockinet

Cut one length of BanLon stockinet and three lengths of orthopedic stockinet at least six inches longer than the stump model. Sew the end of each piece in a curve to match the distal end of the model. Trim the excess stockinet at the sewn end.

### 4. Stockinet Layup

Turn the BanLon stockinet inside out and pull over the model, then follow with two lengths of orthopedic stockinet. Tie the open ends to the base rod. Turn remaining piece of stockinet inside out and pull it over the layup. Smooth the stockinet, pull it down tightly and tie at the base.

### 5. Pressure Sleeve

Prepare a PVA pressure sleeve in the usual manner.\* Pull the sleeve down snugly over the layup and tie at the base rod.

### 6. Mix the Resin

Balance a disposable container (such as a paper cup) on a scale and add the resin, curing agent, and solvent in the proper amounts. The following quantities should be sufficient for the average medium BE socket:

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\* UCLA Manual Upper Extremity Prosthetics, \_\_, 92, 1958.

T.R. 6305

Laminac 4110*	90 g.
Laminac 4134	10 "
Luperco ATC	1 "
Naugatuck Promoter #3	6 drops
Trichloroethylene	43 g.

#### 7. Add the Color

Choose the appropriate color for the individual, using a polyester based color formulation. Stir the proper amount of color into the resin mixture until it is uniformly blended; 1-3 grams will be sufficient for a 100 gm. batch.

#### 8. Impregnation

a) Pour the resin mixture into the open end of the PVA sleeve and work it down into the stockinet. Twisting the end of the sleeve will develop considerable force, aiding impregnation.

b) When the stockinet is fully impregnated, pull the sleeve down as far as possible and string the resin down to the proximal end of the layup until all excess resin has been strung out.

#### 9. Stringing out the Resin

Cut the PVA sleeve and remove it from the layup. Be careful not to spill the excess resin remaining in the bottom of the sleeve. Discard the sleeve and excess resin (any spilled resin may be cleaned with isopropyl alcohol or trichloroethylene).

String the layup down again with a heavy string until no further excess resin appears on the layup.

#### 10. Pre-Cure

Place the layup in a preheated oven set at 47°C. (115°F.) for 30 minutes. This is known as the PRE-CURE. During this stage the solvent will evaporate from the layup leaving it porous.

#### 11. Cure

Remove the layup from the PRE-CURE oven and set the oven at 100°C. (212°F.). At this step in the procedure, the solvent has evaporated and the resin has gelled slightly. If there are any areas in the laminate that contain excess resin, string the resin to the proximal end. When the oven has reached a temperature of 100°C. (212°F) place the laminate back into the oven for one hour. During this hour the laminate will be cured sufficiently to allow the buildup of the outer socket.

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\* Paraplex P-13; P-43 series may be used in place of the Laminac resin.

## 12. PVA Sheet

Remove the laminate from the oven and set the oven at 47°C. (115°F.). As soon as the laminate is cool enough to handle, pull a sheet of PVA over the laminate socket. (This sheet will facilitate release of the outer socket that will be laminated over this inner shell)

## 13. Forearm Build-up

Make the wax forearm buildup in the usual manner and check for the proper length and alignment. After the wax has hardened, remove the paper cone and shape the wax to the desired contour. Remove any wax from the knurled surface of the wrist unit, but leave the wax on top of the wrist unit to protect it from resin during impregnation. Use Polyethylene 629 Wax.\*

## 14. PVA Sleeve

Prepare a PVA sleeve, moisten and pull down over the buildup and trim at the wrist unit.

## 15. Layup Outer BanLon Stockinet

Cut a piece of BanLon stockinet and a piece of orthopedic stockinet 3-5 inches longer than the layup. Cut another piece of orthopedic stockinet a little longer than double the length of the layup. (Additional lengths of stockinet may be used if extra strength is desired) Turn the BanLon stockinet inside out, and pull 1-2 inches over the distal end, and tie at the wrist unit. Trim excess of stockinet that is proximal to the wrist unit.

## Step 16. Layup Orthopedic Stockinet

Take the short piece of stockinet and pull it over the long piece in such a manner that each piece meets at one end. (The other end of the short piece should extend just past the middle of the long piece). Hold the smooth stockinet extended above the wrist unit and slip these piece of orthopedic stockinet (double end first) over the free end and down until the double piece covers the entire layup. Tie at the wrist unit and pull down the two piece of extended stockinet and tie them at the proximal end. The BanLon piece should be on the outside.

## Step 17. Pressure Sleeves

Prepare two PVA sleeves in the usual manner. Turn the shiny surfaces to the inside. Put one sleeve aside for later use; take the other sleeve and pull it over the layup and tie around the pipe at the proximal end.

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\*Semet Solvay Petrochemical Div., Allied Chem. & Dye Corp., New York, N.Y.

## Step 18. Mix Resin

Mix resin and color as described in Step 6. The following quantities should be sufficient for the average medium BE forearm:

Laminac 4110	90 g.
Laminac 4134	10 "
Trichloroethylene	43 g.
Luperco ATC	1 g.
Naugatuck Promoter #3	6 drops
Pigment	As Required

## Step 19. Impregnation

Pour the resin into the PVA sleeve and work it into the stockinet. When the stockinet is fully impregnated, pull the sleeve down as far as possible and string all excess resin down out of the layup.

## Step 20. Strip Sleeve

After the layup has been thoroughly strung down, strip off and discard the PVA sleeve. Now string the layup once more to insure the removal of all excess resin.

As there may be considerable resin in the stockinet around the base pipe, it is necessary to absorb this excess resin in the scrap stockinet wrapped around the base. This will prevent the resin from being drawn back into the laminate during cure.

## Step 21. Pre-Cure

Invert layup, distal end down, and place in a pre-heated oven set at 47°C. (115°F.) for 30 minutes to allow the solvent (trichloroethylene) to evaporate. During the pre-cure moisten the second PVA sleeve by wrapping it in a damp towel for 10-15 minutes.

Step 22. Surface Molding

Remove the layup from the pre-cure oven and pull the moistened PVA sleeve down with light pressure until it covers the entire layup. This light contact pressure is desirable as it will result in the smooth surface required without reducing the porosity. It is very important that the PVA sleeve slide easily over the layup to prevent possible pooling of the resin. There should be no pools on the laminate surface. If there are any string them out. Apply tape around the wrist unit and any severe undercuts.

## Step 23. Cure

Place the layup in an oven pre-set at 100°C. (212°F) for 75 minutes. D During this period the PVA sleeve shrinks around the layup, giving the surface a smooth appearance and aiding in molding to undercuts. At the end of 60 minutes, remove the laminate and strip off the PVA sleeve. At this point the alminate should be firm and tack-free. Replace in oven for the final 15 mins.



#### 24. Mold Removal

Cut layup to the necessary length. Remove the outer socket, PVA, and wax buildup.

#### 25. Trim and Assemble

Hold the prosthesis firmly on the amputee's stump and mark the trim line. Remove the socket and trim in the usual manner. After the socket and forearm have been properly aligned, sand the edges and bond together with 13 parts of ERL 2795 and 7 parts of Versamid 140. Cure the bond area with a heat gun or cure for 1 hour at 100°C (212°F.). Complete harnessing in the usual manner.

### III. APPENDIX

Although the above is considered the simplest procedure for preparing porous polyester laminates, it is not the only method. For other methods consult T. R. 6204 and apply the same procedures to the polyester resins.

### IV. ACKNOWLEDGEMENT

I wish to express my appreciation to Mr. Chester Shelton, Research Limb Shop, for checking out the procedure described above.

<p><b>ABSTRACT CARD</b></p> <p>TITLE: Fabrication Porous Polyester Dble Wall BE Prosthesis 2-Step Method</p> <p>AUTHOR(S): James T. Hill</p> <p>AGENCY: USA Prosthetics Res. Lab.</p> <p>Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6305</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: In a previous report (T.R. 6204) several methods for preparing porous epoxy prostheses were described. Since the publication of this report our laboratory has developed a technique for preparing porous polyester prosthesis. This technique although similar to the epoxy method is sufficiently different to warrant a separate report. This report describes a two-step method for preparing porous polyester prostheses.</p> <p>WRAMC FORM 0183 (ONE TIME)</p> <p>15 MAY 1961</p>	<p>AD _____ # _____</p> <p>1. Porous Polyester Lam</p> <p>2. Fabrication Tech's</p> <p>3.</p> <p>4.</p> <p>UNCLASSIFIED</p>	<p><b>ABSTRACT CARD</b></p> <p>TITLE: Fabrication Porous Polyester Dble Wall BE Prosthesis 2-Step Method</p> <p>AUTHOR(S): James T. Hill</p> <p>AGENCY: USA Prosthetics Res. Lab.</p> <p>Walter Reed AMC, Washington 12, D. C.</p> <p>TECH. RPT. 6305</p> <p>Project 6X59-01-001-04</p> <p>ABSTRACT: In a previous report (T.R. 6204) several methods for preparing porous epoxy prostheses were described. Since the publication of this report our laboratory has developed a technique for preparing porous polyester prosthesis. This technique although similar to the epoxy method is sufficiently different to warrant a separate report. This report describes a two-step method for preparing porous polyester prostheses.</p> <p>WRAMC FORM 0183 (ONE TIME)</p> <p>15 MAY 1961</p>	<p>AD _____ # _____</p> <p>1. Porous Polyester Lam</p> <p>2. Fabrication Tech's</p> <p>3.</p> <p>4.</p> <p>UNCLASSIFIED</p>
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